

# Spreadsheets for learning algebra

## Lessons from a 6th grade curriculum in progress

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Feb. 27, 2016

# **The organization**

## **Illustrative Mathematics**

<https://www.illustrativemathematics.org/>

Founded by Bill McCallum, head writer of the Common Core Math Standards

From their website:

### **Who We Are**

Illustrative Mathematics is a discerning community of educators dedicated to the coherent learning of mathematics.

### **What We Do**

We collaborate at [illustrativemathematics.org](https://www.illustrativemathematics.org/), sharing carefully vetted resources for teachers and teacher leaders to give our children an understanding of mathematics and skill in using it. We provide expert guidance to states, districts, curriculum writers, and assessment writers working to improve mathematics education.

Origin of name: to illustrate the standards with problems and activities. (The actual standards are brief and not completely self-explanatory)

## **Current project**

Open Educational Resources: a complete math curriculum for 6th grade.

Plans for 7th and 8th grade, awaiting funding.

Then elementary and high school?

Free and open source

Multi-format: paper, digital

Source files included so that you can adapt them.

Fully aligned with CCSS.

## Why spreadsheets?

- Spreadsheets use algebra: formulas, variables, expressions
- They are a more concrete way to introduce algebra: start with numbers (See activities later in this session)
- The language of spreadsheets is standard; spreadsheets are a common job tool in the real world
- There are a number of free spreadsheets
- Spreadsheets run on computers, tablets, smartphones

# Why 6th grade?

## 6th Grade Common Core Standards

- (1) connecting ratio and rate to whole number multiplication and division, and using concepts of ratio and rate to solve problems
- (2) completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers
- (3) writing, interpreting, and using expressions and equations
- (4) developing understanding of statistical thinking.

(2) and (4) are especially appropriate for spreadsheets

In the Illustrative Mathematics curriculum, several key topics focus on tables and algebra (in red)

- 6.1 Area and Surface Area
- 6.2 Reasoning about Ratios: Ratios and equivalent ratios; their representations
- 6.3 Unit Rates and Percentages
  - Unit rates
  - Unit conversion problems
  - Percentages
- 6.4 Fraction Division
- 6.5 Operating Fluently on Base Ten Numbers
  - Why the standard algorithms for the four operations work for all base-ten numbers
- 6.6 What Does the Equal Sign Mean?
  - The definition of a solution to an equation
  - What it means for expressions to be equivalent
  - Relationships between quantities defined algebraically
- 6.7 The Left Side of the Number Line (Representing and interpreting negative numbers)
- 6.8 Data Sets and Distributions
- 6.9 Putting It All Together

## Transition to Algebra

Focus on

- variable quantities, not just specific numbers
  - A book of "algebra talks" (Gillan, 1909): *Problems without Figures*



# PROBLEMS WITHOUT FIGURES

FOR

FOURTH GRADE TO EIGHTH GRADE

And for Mental Reviews in

## HIGH SCHOOLS AND NORMAL SCHOOLS

By S. Y. GILLAN.

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THIRD EDITION.

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PUBLISHED BY S. Y. GILLAN & COMPANY,  
MILWAUKEE.

# Problems Without Figures.

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1. If you know three times plus five times plus seven times a number how do you find the number?

2. If you know how much a number with its third added equals, how can you find the number?

3. To find the number of cubic feet in a box, what must you know and what must you do?

4. I know how much one-half of John's money is and how much one-fourth of Ned's money is. How can I find how much money they both have?

5. A boy counted his money and asked the price of a pair of skates, of a pocket knife and of a sled; he then knew how much more money he would have to earn before he could get all of them. How did he find out?

6. Helen knows how much a box of candy will cost and how much a certain book will cost. How may she find out how much money she will have left after paying for the book and the candy?

7. If you are told how long a fence post is and how high it is, how can you find how deep it is set in the ground?

8. Mary has a certain sum of money plus one-fourth as much as Lucy has. If I tell you how much money Mary has, how can you find how much Lucy has?

## Transition to Algebra, continued

Focus on

- relationships between sets of numbers
  - ratios (algebra with training wheels)
  - functions
- reading and writing expressions with numbers and variables, not just the simplified numerical versions (such as  $2 \cdot 10 + 7$  rather than 27)
- solving equations

## **The spreadsheet lessons**

Warning: Drafts! Some more drafty than others

Philosophy:

- Learn mathematical concepts and techniques by hand first
- Then learn to do them in a spreadsheet
- Learn spreadsheet techniques in advance of algebra so that students can use spreadsheets by the time they get there

## **Learning to use a spreadsheet**

### **Lesson 1: Guess My Rule**

Exploration with a premade spreadsheet. See how a spreadsheet does calculations.

### **Lesson 2: Telling a Spreadsheet What to Do**

Arithmetic operations in a spreadsheet, organizing your work

### **Lesson 3: DO copy! It's allowed.**

Saving time and mistakes by copying rather than retyping.

Using a spreadsheet to solve some ratio problems

### **Lesson 4: Don't Change That Address!**

How to prevent addresses from changing when you copy them.

Applications: using a unit price in one cell; multiplication table

A number of optional spreadsheet activities in the units on units and percent, fraction division, base 10 algorithms

## Algebra spreadsheet lessons

### Lesson 5: Guess and Check Tables

Solve equations by making Guess and Check tables. Write an equation.

### Lesson 6: Guess My Rule, Again

Are  $2(x-3)$  and  $2x-6$  the same rule? (Equivalent expressions)

Do some activities from Illustrative Mathematics, grade 6:

[Walk-a-thon 1](#), [Chocolate Bar Sales](#), [The Djinni's Offer](#), [Introducing Equivalent Expressions 2](#), [Seven to the What?!?](#), [Morning Walk](#), [Fruit Salad](#)

Questions, comments, suggestions?

Thanks for your attention.

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## Reference

Gillan, S. Y. (1909). *Problems Without Figures for Fourth Grade to Eighth Grade and for Mental Reviews in High Schools and Normal Schools*. S. Y. Gillan. Retrieved from <http://www.schoolinfosystem.org/pdf/2008/10/problemswithoutfigures.pdf>

